

Upper Mississippi River Nine-Foot Channel Project,
Lock and Dam Complex Number 21
Spanning the Mississippi River between
Quincy, Adams County, Illinois
and
Marion County, Missouri

HAER No. IL-30

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Rocky Mountain Regional Office
National Park Service
U. S. Department of the Interior
P. O. Box 25287
Denver, Colorado 80225

HISTORIC AMERICAN ENGINEERING RECORD

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Location: Spanning the Mississippi River between Quincy, Adams County, Illinois, and Marion County, Missouri; adjacent to the southern edge of Quincy, Illinois, and 324.9 river miles upstream from the confluence of the Ohio and Mississippi rivers. The complex stretches across the river at a point where the valley is wide with flat bottom land on either side of the river. The city of Quincy lies on the low bluffs just along the river just upstream from the complex. The esplanade adjoins the Illinois shore; the lock is just riverward of the esplanade with the movable section of the dam tying to the westernmost lock wall. The earthen embankment section of the dam extends to a levee system protecting the flood plain on the Missouri shore. Corps Drawing Numbers M-L 21 10/1; 10/2; HAER Photograph Numbers IL-30-1 through IL-30-27.

Dates of Construction: 1933-1939

Present Owner: U. S. Government
Rock Island District
Corps of Engineers

Present Use: River navigation/hydrology control

Significance: The U. S. Army Corps of Engineers Nine-Foot Channel Project (1927-1940) represents the culmination of a 100-year effort to improve the navigability of the Upper Mississippi River between the mouth of the Missouri River and Minneapolis, Minnesota. This specific project arose as a response to the farm crisis of the 1920s. Proponents of the New Deal adopted the project and gave speed to its construction as a means of providing public employment during the more general depression of the 1930s. By the 1940s, the completed project had converted over 650 miles of free-flowing river into a series of interconnected reservoirs which ensured enough water for fully loaded modern boats and barges to navigate the system. This constituted a significant alteration of the natural environment of the Upper Mississippi River. However, the project also brought economic benefits to the communities along and around the river corridor and lead to new recreational opportunities for the entire region.

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The Upper Mississippi River Nine-Foot Channel Project inaugurated a new development in slack-water navigation system dam practice in the United States: the adoption of a non-navigable dam containing both roller and Tainter gates. Prior to the Corps' 1930 decision to build non-navigable dams on the Upper Mississippi River, United States Army engineering practice had, nearly universally, been to construct navigable dams, permitting open-river navigation at higher river stages. By 1930, European engineers had been using roller gates in dams extensively for over 25 years. However, only ten such structures had been built in the United States, and these were all located on reaches of rivers where ensuring navigability of any sort was not a design concern. It was not until 1925-1926 that civilian engineers pioneered the use, in the United States, of roller gates in combination with other types of gates. Most of the Corps' Upper Mississippi River project dam designs expanded upon this development, incorporating both roller and Tainter gates. The Corps' shift from navigable to non-navigable dams demonstrate the influence of shipping techniques on navigable waterway improvement technology. It also exemplifies the cautious nature of American Army engineers response to changes in shipping. The Corps' choice of this particular type of non-navigable movable dam illustrates the influence of the hydraulic characteristics of individual rivers on the selection of waterway improvement technologies. It also evidences the manner in which critical engineering design developments are disseminated and become accepted.

Ironically, the Upper Mississippi River Nine-Foot Channel Project also resulted in the obsolescence, by the project's end, of combination roller and Tainter gate dams. Technological advances resulting from the research and development incidental to the design and construction of the 26 lock and dam systems in this project enabled U. S. Army Corps of Engineers to develop both submersible and non-submersible Tainter gates which nearly matched the capabilities of the roller gates. Once these less expensive and easier operated and maintained gates had been developed, American engineers ceased designing or constructing combination roller and Tainter gate dams. The Corps'

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creation of a new dam type and its subsequent
obsolescence during the course of a single project
dramatically illustrates both the evolutionary nature
of American engineering in general and the Nine-Foot
Channel Project in particular (Text, pages 11 and
49-50. See HAER No. IA-23 for complete history,
footnotes and bibliography).

Historian:

Mary Yeater Rathbun

August 1988

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Dates of Erection: 1933-1939
2. Architect/Engineer: U. S. Corps of Engineers, Rock Island District
3. Original and Subsequent Owners: U. S. Government--Rock Island District, Army Corps of Engineers
4. Builders, Contractors, Suppliers:

General Contractor--Lock, Central Control Station, and Esplanade
Construction: Joseph Meltzer Inc., New York, New York,

Subcontractors:

O'Mera Construction Co.	Constructing earth dike around
Quincy, Illinois	upper guidewall, removal and
	disposal of common excavation,
	placing black loam on esplanade
Tri-State Dredging.....	Filling cofferdams, removal of
Keokuk, Iowa	cofferdams and removal temporary
	piling driven for ice protection,
	placing sand in esplanade)
Western Foundation Company.....	Driving timber piling and small
Chicago, Illinois	part of steel sheet piling
C. T. Welsh Dredging Company.....	Removal and disposal of approach
Minneapolis, Minnesota	excavation, production of sane for
	concrete from approach excavation,
	placed fill and protection bank for
	repair of cofferdam break
Corty Motor Company.....	Transport by truck riprap, coarse
Canton, Missouri	aggregate, and derrick stone from
	quarry
Beckman Painting Company.....	Painting all exposed metal work
Chicago, Illinois	
E. A. Wand Plumbing & Heating Co...	Plumbing and heating for central
Quincy, Illinois	control station
Eiff Plastering Company.....	Plastering for central control
Quincy, Illinois	station
Hoener Glass Company.....	Glazing for central control station
Middendorf Lumber Company.....	Roofing and sheet metal work for
Quincy, Illinois	central control station

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Drake Marble Company.....	Tile for floor in central control station
Minneapolis, Minnesota	
Quincy Decorating Company.....	Painting of walls in central control station
Quincy, Illinois	
Mississippi Valley Structural.....	Lock gates, tainter valves, operating machinery, wall armour, structural steel for central control station
Steel Company	
Melrose Park, Illinois	
Pittsburgh Screw and Bolt Co.	Screws and bolts
Pittsburgh, Pennsylvania	
Michigan Products Corp.	Structural steel
Chicago, Illinois	
E. E. Armarcy, Jr.	Steel bars, hexagonal nuts and locks
Chicago, Illinois	
Illinois Steel Company.....	Steel sheet piling, angles, beams, channels, and sheared plates
Chicago, Illinois	
R. C. Mahon Company.....	Wall armour
Detroit, Michigan	
Arthur J. O'Leary and Sons.....	Ladder rungs, drift bolts, and mooring hooks
Chicago, Illinois	
American Steel and Wire Co.	Zinc slabs
Cleveland, Ohio	
American Steel and Wire Co.	Cables for operating machinery
Pittsburgh, Pennsylvania	
Alemite Company.....	Alemite fittings
Pittsburgh, Pennsylvania	
Hodgson Foundry Company.....	Bronze rings
Chicago, Illinois	
Hubbard Steel Foundry.....	Grease and pinion for operating machinery
Chicago Metal Manufacturing.....	Metal gear housings and hoods
Chicago, Illinois	
Allegheny Steel Company.....	Corrosion-resisting steel
Chicago, Illinois	
Murry Copper and Bronze Co.	Bronze bushings and bronze steel strips
Pittsburgh, Pennsylvania	
Tuscon Steel Company.....	Screen doors, lock and keys for central control station
Chicago, Illinois	
American Spiral Spring & Mfg. Co. .	Springs for tainter valves and miter gate operating machinery
Pittsburgh, Pennsylvania	
General Electric.....	Electric cables
Chicago, Illinois	
American Skein and Foundry Co.	Junction boxes, manhole frames and covers
Racine, Wisconsin	

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General Contractor--Dam Construction: McCarthy Improvement Company,
Davenport, Iowa

Subcontractors:

American Bridge Company.....	Fabrication, erection, and
Pittsburgh, Pennsylvania	placement of all structural
	steel, roller and tainter
	gates, operating machinery
	for same, crane track, hand
	railing
Beckman Painting Company.....	Painting of bridge and gates
Chicago, Illinois	
E. A. Whitney and Sons, Inc.	Pile driving test piles
L. Morgan.....	Placing derrick stone
C. H. Wurst Company.....	Place felt, pitch, gravel, and
Quincy, Illinois	copper flashings and
	downspouts on pier house roofs

General Contractor--Power, Control, and Lighting System Construction:
E. A. Koeneman Electric Company, St. Louis, Missouri

Subcontractor: American Hoist and Derrick (haulage units)

General Contractor--Storehouse and Garage on Esplanade Construction:
C. H. Langman & Son, Rock Island, Illinois

5. Original Plans and Construction:

U. S. Army Corps of Engineers, Rock Island District, plans for lock submitted by associate engineer Edwin E. Abbott. By the time he submitted the drawings for the dam, Abbott had been promoted to senior engineer.

6. Alterations and Additions:

<u>Item</u>	<u>Year</u>
Construction-500-foot cell foundation concrete extension to upstream end of river wall of lock	1940-1942
Land wall and lock gate handrails lowered by one rail and new handrail made from salvaged materials installed on both edges of each lock wall and on upstream side of walkways on top of lock gates	ca. 1945

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Construction-handrail on upstream side of dam service bridge	ca. 1945
Construction-upstream guidewall extension	1951
Construction-frame air-lock vestibule at upstream end door of central control station	ca. 1970
Addition-boat launches on lock walls	ca. 1970
Replacement-haulage units	ca. 1971 and 1973
Construction-metal and glass shelters around land wall control cabinets and at end of the guidewall of lock	ca. 1972
Removal-Lockmaster/Assistant Lockmaster residences from esplanade	ca. 1975
Removal-standby generator for machinery room of central control station	ca. 1975
Construction-emergency generator building	ca. 1975
Replacement--wooden plank hatches on dam service bridge with aluminum ones	ca. 1979
Installation-traveling mooring kevels extending length of guidewalls of lock	1980
Construction-new workshop building	1980-81
Replacement-crane on dam	1983-84
Replacement-light posts and light fixtures around lock	1984
Replacement-exterior wall covering of central control station and frame air-lock with brick one incorporated into main building	1985

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B. Historical Context:

The special board of engineers which initially designed the Nine-Foot Channel Project between 1929 and 1931 saw the construction of Lock and Dam Complex 21 as a high priority and placed it in the fourth group of projects to be constructed. The fact that the complex was adjacent to a large population center, Quincy, which had an acute unemployment problem, accounts for the fact that complex 21 was constructed before some of the others in the progressive improvement of the Upper Mississippi River.

The construction of Lock 21 was not routine. The cofferdam surrounding the lock construction site broke in April 1934, flooding and damaging the excavation, crib-work, rip rap and piling put in during the first four months of construction. This delayed the project for about a month.

When Joseph Meltzer Inc. finished the lock, central control station, and esplanade, and when the government accepted the work on August 20, 1935, there was no money available with which to begin the next part of the project, the dam. Representatives of all segments of the Quincy community began lobbying vigorously to get federal money released to construct the dam as a work relief project. These efforts paid off. Within a year, funds had been found with which to build the dam. The Corps gave the McCarthy Improvement Company of Davenport, Iowa, the order to start construction on August 14, 1936. From that point on, the construction project was relatively routine.

Most specific items of engineering significance at complex 21 relate to the dam. The Rock Island District designed Dams 12 and 21 concurrently. Both were built concurrently with Dam 22. Dams 12, 21, and 22 were the first in the Rock Island District to employ 2b roller gate piers. All three were apparently designed, but the piers not necessarily completed, before the Rock Island District changes the design so that the open space which would have appeared below the pier house on these piers was filled with a steel diaphragm.

The lock and dam elements of the complex took over five years to complete (or over a year and a half longer than average (at a cost of \$5,721,000. The complex was placed in operation as a unit of the Upper Mississippi River Nine-Foot Navigation Project on July 23, 1938. It was the seventh of the 1931-1940 Upper Mississippi River Nine-Foot Navigation Project complexes in the Rock Island District to go on line.

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PART II. TECHNOLOGICAL INFORMATION - LOCK

A. General Statement:

1. Design Character: Standardized Ohio-Mississippi Lock Design.
Drawing Number M-L 21 20/1B.
2. Condition of Fabric: Excellent

B. Description of General Layout and Principal Elements:

1. Overall dimensions: Main lock chamber - 110 feet wide by 600 feet long by 40 feet high; adjoining incomplete auxiliary lock chamber 110 feet wide by 40 feet high. Lift - 10.5 feet. Drawing Number M-L 21 20/1B.
2. Foundations: 30-foot-round timber pile with 25 to 30-foot sheet pile cutoff walls enclosing outside limit. Drawing Number M-L 21 20/2B.
3. Walls: Reinforced monolithic concrete with steel rub bars on their chamberward faces upstream and downstream from the lock gates. Land wall adjoins Illinois shore. Intermediate wall is riverward wall of main lock and landward wall of incomplete auxiliary lock. River wall of auxiliary lock ties to dam on west. Drawing Numbers M-L 21 20/4B, 20/6B, 20/9B, 20/5B, 20/19A, 20/20B, 20/28.
4. Structural System: See above.
5. Bullnoses: Concrete configurations at each end of intermediate wall. Drawing Number M-L 21 20/19A.
6. Upper and Lower Guidewalls: Extended monolithic reinforced concrete walls extending the landwall out of the lock chamber at either end to assist guiding of barge traffic into the lock. Drawing Number M-L 21 20/11B.
7. Riverwall Extension: 500-foot long cell foundation, concrete extension to upstream end of riverwall. Added 1940-42 to assist in counteracting outdraft which made navigation into and out of the upstream end of the lock difficult. Drawing Numbers M-L 21 10/19A; M-O 32/11.
8. Guidewall Extension: Concrete-covered extension to upstream guidewall. Added in 1951 to assist in counteracting outdraft which made navigation into and out of the upstream end of the lock difficult.

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9. Stage Recorder: Small concrete housing located at the end of the downstream guidewall. Equipment housed for the recording of river stages.

C. Mechanical Equipment:

1. Tainter Valves: Four cable drive lock valves of steel construction with electric motorized assembly. Valves are located in wells in lock walls. They are operated by switches in weather-proof control cabinets on lock walls, with a cabinet beside each gate recess. Control cabinets on landwall surrounded by metal and glass shelters since mid-1970s. Drawing Numbers M-L 21 25/1, 28/1, 20/12.
2. Gates: Two pairs of miter gates on main lock and one pair on upstream end of incomplete auxiliary lock. All three pairs are balanced on stainless steel pintels. Those in main lock are operated by arms, gears, and electric motor assemblies. Motor assemblies housed in machinery pits in lock walls adjacent to each leaf. The gates are operated by switches in control cabinets; switching assemblies also replaced between 1986 and 1988. Bumper lines of chamber face of gates also of stainless steel. All other associated metal parts are of steel, stainless steel, or steel/nickel alloy. Drawing Numbers M-L 21 21/1A, 21/17A, 22/1.
3. Lighting: Various freestanding single and double head lighting standards, installed in 1984.
4. Plumbing: Lock is watered by the Tainter valves (see previous page) serving a system of cast-in-place tunnels that enable the water level to be controlled on the interior of the lock.
5. Haulage Unit: Motorized winch assembly to assist towing of barges through lockage. Replacement units were installed in the mid-1970s.
6. Traveling Mooring Kevels: Two large cleats on rails which extends the length of both the upstream and downstream guidewalls. Installed in 1980, the kevels are used to assist towing of barges through lockage.

D. Other Elements:

1. Auxiliary Lock: Fixed miter gate without machinery and partial walls are located riverward of the main lock. It is equipped with wells for machinery placement, but was never completed or put into service. Drawing Numbers M-L 21 20/1; 20/5B.

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2. Boat Launches: Installed ca. 1970, the launches are single-armed derricks of metal construction.

PART III. TECHNOLOGICAL INFORMATION--MOVABLE SECTION OF DAM

A. General Statement:

1. Design Character: Combination roller/tainter low dam system design. Drawing Number M-L 21 40/1.
2. Architectural Character: 2b roller gate piers. Drawing Number M-L 21 40/2
3. Condition of Fabric: Excellent.

B. Description of Exterior

1. Overall Dimensions: 1,265 feet in length. Drawing Number M-L 21 40/1.
2. Foundation: 30-floor round timber pile with 25 to 30-foot sheet piling cutoff wall enclosing outside limit.
3. Pier House Walls: Monolithic reinforced concrete. Drawing Numbers M-L 21 41/1 and 41/2.
4. Structural System: Monolithic concrete/structural steel.
5. Fenders: Concrete fenders located at the base of each pier.
6. Openings:
 - a. In Overall Structures: 13 water-channels and 2 archways; clustered in groups by sizes, east to west--5 water-channels ca. 64 feet wide; 3 water-channels ca. 100 feet wide; 5 water-channels ca. 64 feet wide; 2 archways ca. 60 feet wide. Drawing Number M-L 21 40/1.
 - b. In Pier Houses: 1 doorway, 1 floor hatch, and 11 three-paned windows for each of four pier houses.. Drawing Number M-L 21 40/2, 41/4.
 - (1) Doorways and doors: 4
 - (2) Windows: 44

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- c. In Access Tower: 2 doorways and doors. Drawing Number M-L 21 40/4.

7. Roofs:

- a. Shape, covering: Pier houses have hipped roofs covered in membrane/tar. Drawing Number M-L 22 41/3.
- b. Towers, abutments, piers: 2 abutments; lockwall abutments includes access tower; 14 piers (8 tainter gate piers, 2 2b-style roller gate piers, 2 2b-style transition piers or combination tainter and roller gate piers, and 2 service bridge extension piers); 4 2b-style piers have pier house towers. Drawing Numbers M-L 21 40/1, 40/4, 40/17A, 40/3, 40/2, 40/10, 40/11, 40/13, 40/25.

8. Service Bridge:

- a. Shape: Arched spans in a segmental series.
- b. Materials: Structural steel. Drawing Number M-L 21 53/1.

C. Description of General Layout and Principal Elements:

- 1. Access Plan: Simple stairway in the access tower which itself is part of the abutment resting on the riverwall of the auxiliary lock. This stairway leads to service bridge deck where walkway/rail tracks extend full length of dam. Access to all four pier houses directly off deck. Access to storage yard below easternmost 200 feet of dam by simple exposed stairway at the western end of service bridge. Drawing Numbers M-L 21 40/1, 40/4, 53/1, 53/9, 53/10.
- 2. Stairways: In access tower--reinforced concrete with pipe railing; at end of service bridge extension--open metal with pipe railing. Drawing Numbers M-L 21 40/4, 53/1.
- 3. Flooring: In pier houses and access tower--reinforced concrete; on service bridge deck--wooden plank. Drawing Numbers M-L 20 40/4, 40/7, 53/10.
- 4. Wall and Ceiling Finish: Reinforced concrete. Drawing Numbers M-L 21 40/4, 40/5.
- 5. Hardware: Brass.

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D. Mechanical Equipment:

1. Movable Gates: Ten 64-foot-wide by 20 feet high, 2b-type Tainter gates operated by line shafts and motors housed in installations above each gate; 3,100-foot-wide by 20 feet high submersible roller gates operated on tooth track by chain driven hoist machinery located in pier house adjacent to each gate. Drawing Numbers M-L 21 48/1, 47/1, 55/1, 54/2.
2. Movable Crane: 30-ton vertical lift electric crane with 70-foot boom (replaced in 1980) used for moving parts and equipment. Sits on original (ca. 1938) crane trolley which also supports additional bridge crane used for lifting emergency bulkheads, etc. Trolley rides on 15-gauge track system running entire length of service bridge deck. Drawing Numbers M-L 21 53/11, 53/13, 53/13, 58/6.
3. Lighting: Fixtures as of times of installation - 1937-39. Rewiring may have taken place over the years--extent is unknown. Drawing Number M-L 21 56/1.

E. Other Elements:

1. Earth Dikes: Three dikes in segmental series--140-foot-long earth and sand-filled transition dike extends from western end of storage yard to 1,400-foot-long earth and sand-filled submersible dike followed by another 140-foot-long transition dike to levee along Missouri shore. Drawing Numbers M-L 21 40/1, 52/1, 52/2.
2. Emergency Bulkheads: Temporary block units of riveted structural steel girder construction placed in gate openings in periods of emergency or repair. Drawing Numbers M-L 21 58/1; 58/4.
3. Emergency Bulkhead Car/Tracks: Located in storage yard, the flat cars designed to store and access bulkheads. Drawing Number M-L 21 53/13, 40/27.
3. Storage Yard: 200-foot-long area extending from east abutment under service bridge extension, i.e., under last two archways in dam. The yard contains replacement parts for gates, bulkheads on track cars and related items. Drawing Number M-L 21 40/27.

PART IV: TECHNOLOGICAL INFORMATION-ESPLANADE AREA

A. Description of Esplanade--General Layout:

1. Design Character: Standardized park/service area and access road component. The main esplanade area was originally designed to accommodate the Central Control Station, Lockmaster and Assistant Lockmaster Residences, parking, an access road, and other service-related functions. Major site alterations have occurred since that time and are noted in the following items.
2. Architectural Character: 1a Central Control Station. Drawing Number M-L 21 70/1A.
3. Historic Landscape Design: Based on standardized designs--see drawings for Lockmaster's residences.

B. Condition of Site and Structures: Altered

1. Central Control Station - Exterior: Standardized 1a construction. Major alteration in 1985 rehabilitation project placed insulation and face brick over original concrete finish. For original, see Drawing Number M-L 21 70/1A. Drawings for rehabilitation available from Rock Island District Office.
 - a. First Floor: Contains machinery room where central control panel located, bathroom, main office, and basement stairway access. Standby generator which dominated machinery room removed in mid-1970s. Drawing Number M-L 21 70/2A.
 - b. Basement: Contains storage and equipment rooms. All interior finishes altered from original construction. Drawing Number M-L 21 70/2A.
2. Lockmaster's/Assistant Lockmaster's Residences (standardized, Colonial Revival with side porch): The structures has been moved off site to locations in Quincy, Illinois. Related structures, such as garages, have been demolished.
3. Outbuildings: Various shed and service buildings have been erected from time to time as demands required--none have particular significance or contribute to the site. A metal emergency generator building was constructed just upstream from the Central Control Station in the mid-1970s. It is a standardized element. A new garage structure of brick and steel was erected on the old site of the Lockmaster's residence ca. 1980. This element is also standardized.

PART V: SOURCES OF INFORMATION

- A. Original Architectural/Engineering Drawings: Mississippi River Lock and Dam 20, lock operations folio, February 1936, file No. GP67-1; Mississippi River, Lock and Dam 21, dam operations folio, Rock Island District Office-Construction Drawings--Mississippi River Locks and Dams 1937-1986, (passim), Rock Island District Library, Clock Tower Building Annex, Rock Island, Illinois.
- B. Early Views: Over 1,600 high quality 8x10 black and white construction photographs: Lock and Dam Number 21-Photo Book groups 121.14 (3 vols.), 2145, 2120, (4 vols.), Rock Island Arsenal, Rock Island, Illinois.
- C. Interviews: Present and past personnel--Lock and Dam Number 21.
- D. Bibliography:
 - 1. Primary and unpublished sources: National Archives Record Group 77, Entry 81, Chicago National Archives and Records Center; National Archives Record Group 77, Entries 111 and 112, Washington National Records Center, Suitland, Maryland; Chief of Engineers Annual Reports, 1927-1987; see also bibliography in HAER No. IA-23 narrative history.
 - 2. Secondary and published sources: See bibliography in HAER No. IA-23 narrative history.
- E. Likely Sources Not Yet Investigated: National Archives Record Group 77, Entry 107 (132 linear feet), Washington National Records Center, Suitland, Maryland; National Archives Record Group 77, Entry 1656, exact repository unknown; and National Archives Record Group 77, Entries 608, 609, and 610 (collective total 5 linear feet), National Archives, Washington, DC.
- F. Supplemental Material: 83 film canisters of 1931-1939 silent movies of the construction process taken by the Corps of Engineers, Rock Island District Office, Rock Island Arsenal, Rock Island, Illinois.
- G. Notes: The notes for this outline are contained in the notes section of HAER No. IA-23 narrative history.